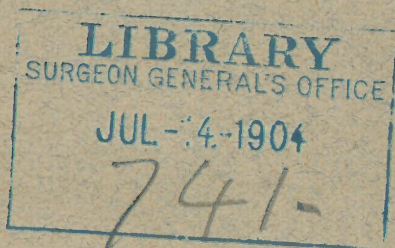
 von BOKAY (J.) & PLUMMER
(Ed., Nl.)

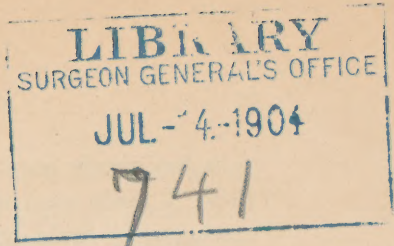
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MEMBRANE AND OCCLUSION
OF THE TUBE TAKE PLACE IN
O'DWYER'S INTUBATION, AND
OF WHAT IMPORTANCE ARE
THESE COMPLICATIONS ?

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Director of the Stefanie-Kinderspital, Budapest.
Translated from the German with the special
sanction of the author, by

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Surgeon to the Massachusetts Charitable Eye and
Ear Infirmary; Aural Surgeon to the Long
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WHENEVER a comparison between tracheotomy and intubation is made, the adherents of tracheotomy are accustomed to lay special stress on the possibility of pushing down the membranes and of the tube becoming occluded, as a great disadvantage of intubation. My purpose, on this occasion, is to discuss this question, which, from a practical point of view, is of importance, and in trying to throw light thereon, I believe that the results of my efforts will not be without value.

In almost every contribution from the adherents of intubation, since O'Dwyer's procedure has been mentioned in literature, we find the statement that, during intubation, pseudo-membranes may be pushed down and the tube may become occluded by pseudo-membranes. Even the first observers, J. O'Dwyer, Francis Huber and Dillon Brown, called the attention of their American colleagues to this contingency, in the year 1887, in their reports to the "Academy of Medicine" in New York, when they made public the procedure known as intubation. Indeed, this very fact led O'Dwyer at the same time, to urge upon physicians the necessity of being fully prepared to resort to tracheotomy when performing intubation. O'Dwyer's conscientious advice is always faithfully followed by operators, although, as we shall see, the necessity for performing tracheotomy immediately after in-

tubation, rarely occurs. As for myself, even in my first intubations, I made such arrangements in my hospital practice that tracheotomy could be performed at any time in the diphtheria pavilion. Furthermore, whenever intubation is called for in my private practice, I carry with me all the instruments necessary for tracheotomy, and shall not neglect to take that precaution in the future.

As intubators have never denied the possibility of pushing down the membrane during intubation, or of the tube becoming occluded, the question can only be, how often does this complication arise, and of what importance is it? Does it really take place so frequently and is it of so dangerous a nature, that preference in the two operations, belongs by right to tracheotomy?

O'Dwyer,¹ Fr. Huber,² Dillon Brown,³ Waxham,⁴ von Ranke,⁵ Ganghofner,⁶ Baer⁷ and McNaughton,⁸ all emphasize the fact, that only exceptionally in their experience, has the pushing down or pseudo-membranes taken place. Occlusion of the tube by pseudo-membranes is also but rarely reported by intubators. Von Ranke, the pioneer of intubation in Germany, makes the following statement: "When the tube is introduced, we may, doubtless, be suddenly confronted with danger of suffocation, but according to our observations in Munich, this complication is very rarely encountered. The experience of American physicians also corroborates this fact."

Practice, therefore, has failed to substantiate objections based on theory; indeed experience has undoubtedly shown, that the complications under discussion are only encountered sporadically. And why is the pushing down of pseudo-membranes, during the introduction of O'Dwyer's tube, of so rare occurrence, when if looked upon from a purely theoretical standpoint, it might be supposed to be a frequent complication?

1. Because the edges of the lower end of the tube are rounded and when the latter, rightly mounted with the obturator, is in-

(1) The Medical Record, 1887.

(2) Ibid.

(3) Ibid.

(4) The Journal of the American Medical Association, 1892.

(5) Verhandlungen der Gesellschaft für Kinderheilkunde, Heidelberg, 1889.

(6) Ibid.

(7) Deutsche Zeitschrift f. Chirurgie, 1892.

(8) The Brooklyn Medical Journal, 1893.

serted through the glottis, and is not too soon freed from the obturator, the possibility of detaching the pseudo-membrane is greatly diminished by reason of this completely rounded extremity.

2. Because thick pseudo-membranes are extensively formed only in extremely rare cases, even in the most virulent epidemics, while thinner pseudo-membranes even of larger dimensions, comparatively speaking, easily pass through the tube. On this account, the detaching of these membranes, can hardly be considered of enough importance to be deemed a complication.

3. Even if thick membranes are formed in the upper air-passages, they usually have their origin below the vocal cords, and in this case, the tube easily penetrates into the lumen of the pseudo-membranes. If, however, the latter adhere to the vocal cords, they are more firmly attached to this place,* so that the tube when introduced with necessary care, can hardly pass between the pseudo-membrane and the tracheal wall.

4. Because the ominous difficulty of breathing—even in the most severe croup cases—is not conditional upon the fibrinous exudate alone, but may be attributed to the subglottic swelling that is present as a rule (Rauchfuss†).

And why is obstruction of the tube by pseudo-membranes a rare occurrence?

1. Because, as before stated, very thick pseudo-membranes are seldom extensively formed and thinner fibrinous pellicles if detached, especially when broken, pass through the tube with comparative ease.

2. If the croupous process does not rapidly descend or, more properly speaking, remains confined to the trachea, the fibrinous exudate may be dissolved by rational treatment (inhalations of hot steam, mercury-therapy) and expectorated by the patient in the form of a slimy secretion, and this secretion never obstructs the tube.

Let us now examine the literature at our disposal, to ascertain in how many cases the subsequent performance of tracheotomy became necessary on account of the danger to life from detachment of pseudo-membrane.

*Birch-Hirschfeld, Lehrbuch der path. Anatomie.

†Compte rendu des travaux de la Section de Pédiatrie, Copenhague, 1885.

Such cases happened in the practice of the following observers:

1887: Ferguson, ¹ New York.....	1 case.
1888: Thiersch, ² Leipzig.....of 31 observations,	1 case.
1888: Graser, ³ München.....of 4 observations,	2 cases.
1889: Guyer, ⁴ Zürich.....of 27 observations,	1 case.
1889: Ganghofner, ⁵ Prag.....of 41 observations,	6 cases.
1889: Ranke, ⁶ München.....of 65 observations,	2 cases.
1890: Widerhofer, ⁷ Wien.....of 142 observations,	1 case.
* 1892: V. Muralt and Baer, ⁸ Zürich.of 74 observations,	1 case.
1892: MaNaughton, ⁹ New York..of 143 observations,	1 case.
1893: Schweiger and Hüttenbren- ner, ¹⁰ Wien.....of 70 observations,	2 cases.

of 498 observations, 18 cases.

Of 498 intubation cases, therefore, an immediate tracheotomy became necessary in $3\frac{1}{2}$ per cent.* Tracheotomy failed to relieve the asphyxia in only two of these cases to my knowledge—and these patients died from the pushing down of pseudo-membranes. One of these cases occurred in the practice of Dr. Von Muralt, the other, in that of McNaughton. In Von Muralt's case (reported by Baer) intubation was performed in the death agony. Post-mortem examination showed, besides the detachment of pseudo-membranes, bronchitis crouposa and extensive pneumonia. That a tracheotomy, moreover, in spite of the forcing down of thick pseudo-membranes, does not appear to be absolutely necessary in all cases, is sufficiently proved by the extensive casuistry published by intubators. Immediate extubation leads, in most cases, to the result that the loosened pseudo-membrane is ejected by violent coughing, either simultaneously with the tube

(1) New York Med. Journal, 1887.

(2) Verhandl. der deutschen Gesellschaft f. Chirurgie, 1888.

(3) Münchener Med. Wochenschrift, 1888.

(4) Correspondenzblatt f. Schweizer Aerzte, 1889.

(5) Verhandl. d. Gesellschaft f. Kinderheilkunde, Heidelberg, 1889.

(6) l. c.

(7) Pädiatrische Arbeiten, Henoch-Festschrift.

(8) Deutsche Feitschrift f. Chirurgie, 1892.

(9) l. c.

(10) Jahrbuch f. Kinderheilkunde, 1893.

*In this paper, I have made use of those communications only in which cases of pseudo-membrane displacement were distinctly mentioned.

or directly after it. O'Dwyer,¹ Dillon Brown² and Waxham,³ for instance, emphasize this fact. In some cases, the membranes were forced out by artificial respiration. In other cases, expectoration of the pseudo-membranes was facilitated by the immediate administration of strong alcoholic stimulants (brandy) and the severe cough caused by this agent. (The liquors were inhaled, that is to say, by the gasping patient, by which means, the latter was seized with a violent fit of coughing).

Those who dread the pushing down of pseudo-membranes in the practice of intubation, may be consoled by the fact that, until 1891, O'Dwyer and Dillon Brown,⁴ out of more than 600 intubation cases, did not meet with a single death, which was due to suffocation on account of pushing down pseudo-membranes; further, that O'Dwyer⁵ in his first 200 cases, pushed down pseudo-membranes only twice. The consequent asphyxia, however, was quickly relieved by immediate extubation, followed by expectoration of the pseudo-membrane.

That a brilliant result may be obtained even in the event of pushing down the pseudo-membrane, is proved by the following remarkable case of O'Dwyer's,⁶ which we briefly report:

O'Dwyer performed intubation on a child $3\frac{1}{2}$ years old, on account of a very severe stenosis, resulting from diphtheritic croup. Asphyxia ensued, caused by pushing down pseudo-membrane. Immediate extubation was followed by expectoration of a large pseudo-membrane, showing a cast of the trachea, and as the breathing was not relieved, reintubation was done. After intubation, breathing was perfectly clear. At the expiration of 26 hours, the tube was expectorated by the patient. A second intubation was unnecessary.

The pushing down of pseudo-membranes, is considered a frequent complication, only by those who perform intubation but rarely, and on that account, are not sufficiently skilled in the operation. Dillon Brown* thinks it possible that the ostensible push

(1) l. c.

(2) l. c.

(3) The Journal of the American Medical Association, 1892.

(4) Transactions of the American Pediatric Society, 1891, p. 24.

(5) J. Bull, Intubation of the Larynx, London, 1891, p. 24.

(6) N. Y. Medical Journal, 1888.

*Transactions of the American Pediatric Society, 1891.

ing down of pseudo-membranes is really not pushing down, but asphyxia caused by prolonged, that is, unskillful attempts to introduce the tube. "I venture to state that the great majority of deaths, which have been reported as due to pushing down pseudo-membrane, were the result of unskilled efforts and due either to apnoea from prolonged attempts at introduction, or to asphyxia by forcing the tube through a false passage." About the same may be said of occlusion of the tube by pseudo-membrane. It is met with now and then, but not frequently. It becomes dangerous only when not under sufficient control, that is, in these cases where immediate extubation is neglected. In such cases, however, spontaneous extubation frequently takes place. The patient ejects the tube in a violent fit of coughing and simultaneously, the obstructing membrane. It is undoubtedly true that O'Dwyer's tubes are comparatively narrow (narrower than the tracheal canulæ), but it is claimed by the most prominent intubators that despite this, large pseudo-membranes can be ejected through these tubes. Indeed—to cite merely from German literature—Baer (v. Muralt, *Zuricher Kinderklinik*) reports several cases where the patient expectorated large pseudo-membranes through the tube.

A nine-year-old child expectorated in nine days pseudo-membranes of $6\frac{1}{2}$, 3, 5, 3 centimetres in length, largely through the tube, which was retained in all eighteen days and four hours. Number of intubations, 34; the tube was coughed out 15 times. Cure.

In another case, a four-year-old child expectorated 8 pseudo-membranes of considerable size, principally through the tube. Number of intubations, 9. The tube was retained in all $145\frac{1}{2}$ hours. Cure.

We emphasize the fact that secondary tracheotomy was not performed in either case. Although Escherich* maintains that the greatest disadvantage of intubation is the excessively difficult and exhausting expectoration of pseudo-membranes, yet the above-mentioned instances, as well as numerous cases cited by other intubators, with the same happy result, ought to greatly diminish the value of his assertion.

On the whole, I find in the collective literature, only a single case where obstruction of the tube by pseudo-membranes resulted in death from suffocation; it is that of Wheeler† in the year 1887.

**Wiener klinische Wochenschrift*, 1891.

†*l. c.*

Immediate extubation, however, was neglected. Huber,* who reported the case, considered it probable that immediate extubation would have saved the patient's life. For my part I have no doubt but that several fatalities have occurred in consequence of occlusion of the tube. Among the weaknesses of mankind, belongs the dislike of reporting failures. That this unpleasant complication has had fatal results only sporadically, is sufficiently proved, in my opinion, from the literature of intubation.

In this connection, I would like to mention that O'Dwyer† has recently devised round tubes, shorter and of larger calibre than those in general use, for the easier expulsion of the thicker pseudo-membranes (see fig. 1). These tubes are characterized by their un-

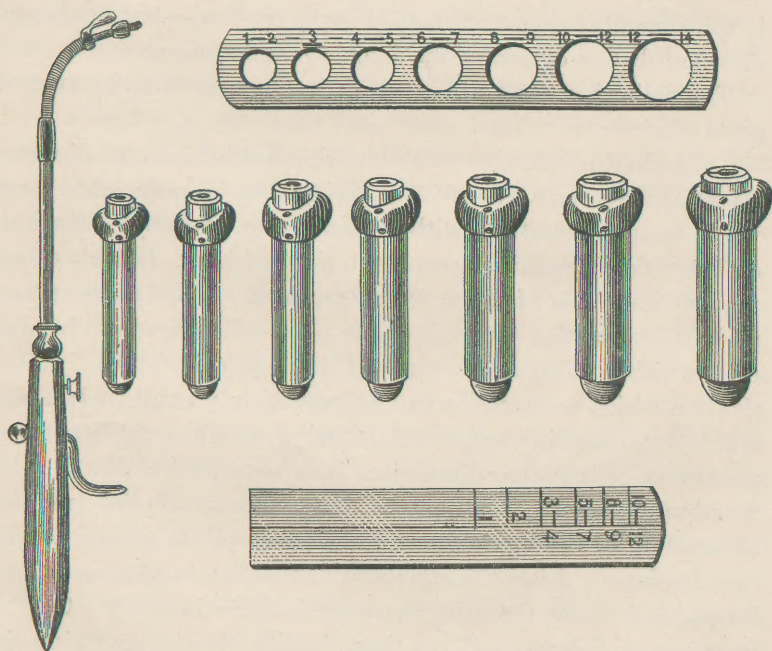


FIG. 1.

usually large collars, straight shaft, and large lumen. The length of the largest tube is 3 centimetres, while in O'Dwyer's original tubes, the length varies between 4 and 7 centimetres.

O'Dwyer recommends the use of these short, broad tubes, for but a short time, 1-3 hours, and then only in cases where clinical

*New York Medical Journal, 1887, February 27.

†Waxham showed these tubes in the Chicagoer Aerzte-Verein in October, 1890.

symptoms of detached membrane are undoubtedly present. Leaving these tubes longer in the larynx is not to be advised, as they might cause decubitus. In the use of these tubes, therefore, we cannot dispense with the original O'Dwyer tubes.

I have used them, myself, only a few times, and can state merely, that their introduction is most difficult, even for very skilful intubators.*

In the children's hospital under my charge, I have performed more than 500 intubations, and among my collective patients, not one death resulted from pushing down pseudo-membranes, although this accident has happened several times. In three or four cases, this might have resulted fatally,—as large and unusually thick membranes were detached in the trachea,—had not immediate extubation overcome the danger of suffocation.

The following cases are cited, as instructive from a practical point of view:

1. Katharine Sz., nine-year-old girl, admitted into the diphtheria ward, February 26, 1892. Patient has been feverish for a week, coughs, breathed with difficulty for one day. Medium diphtheritic process in throat, stenotic breathing, decided symptoms of a stenosis of the upper air-passages. The dangerous stenosis, together with pronounced cyanosis, call for prompt intubation, which is done at 11 a. m. Livid asphyxia follows intubation, on which account, patient is immediately extubated; a violent fit of coughing supervenes, during which a thick pseudo-membrane of imposing dimensions is expectorated. The pseudo-membrane is 13 centimetres long, a cast of the trachea, bifurcation of the bronchi, even of the second, third and fourth ramifications. After the expulsion of the pseudo-membrane, the breathing is clear, the tube, however, is again inserted. On the morning of February 27, as there is difficulty in breathing, in spite of the tube secondary tracheotomy is performed, but without success; early on February 28, symptoms of bronchitis crouposa and pneumonia having developed, death took place. Post-mortem examination showed: Superficial diphtheria of the fauces, laryngo-trachitis and bronchitis fibrinosa. Pneumonia

*O'Dwyer recommends these tubes, also, when foreign bodies have entered the upper air-passages, provided they are movable. In one case of this kind, I have attempted to do this, without success, however. Patient cured by tracheotomy.

crouposa of the upper and middle lobes of the right lung with pleuritis fibrinosa of the same side.

It is worthy of mention, that a perfect copy of the expectorated pseudo-membrane was found in the air-passages, which clearly proves that in cases of so marked severity, the membranes may be reproduced very quickly.

2. Serena B., five-year-old girl, admitted into the hospital August 24, 1893, has been ill for four days, complaining of sore throat. Recovered from measles three weeks ago. Medium diphtheria of the fauces besides stenosis to a marked degree. Shortly after admission, patient was intubated, after which respiration seemed to be only partially free. At 7 a. m., on August 25, extubation was done on account of cyanosis, after which patient coughed out a thick pseudo-membrane, 9 centimetres long, a cast of the trachea, the bifurcation and second and third divisions of the bronchial tubes. Reintubation was performed, after which the breathing became perfectly free. On the night of August 25, cyanosis is again observed and extubation immediately performed, but without success; therefore, the tube is again inserted. Asphyxia follows, on account of which the tube is removed, still without success. The asphyxia is finally relieved by artificial respiration. Patient soon begins to cough and ejects a thick pseudo-membrane. The breathing becomes free. The membrane is 13 centimetres in length, and shows a cast of the trachea and of the third, fourth and even the fifth division of the bronchial tubes. On August 26, in spite of recent intubation, the condition becomes critical, and on the afternoon of the same day, death takes place with symptoms of bronchitis crouposa and pneumonia.

In this case, we had the opportunity, again, of seeing the rapid reproduction of pseudo-membrane.

3. Marie S., ten-year-old girl, admitted October 1, 1893. Sore throat for four days. Very extensive diphtheritic process of fauces and nose with marked pharyngeal stenosis. Offensive breath, voice hoarse. On October 2, hoarseness more noticeable. October 3, laryngeal stenosis, developing rapidly. At 4 p. m., expectoration of a pseudo-membrane by violent coughing upon which the breathing becomes free; intubation unnecessary. The membrane is nine centimetres long and was formed in the trachea. Stenosis again sets in on the morning of the 4th on account of

which intubation is performed; asphyxia follows; extubation immediately performed; the patient coughs out a pseudo-membrane, whereupon the breathing is free. The latter was formed in the trachea, and is 10 centimetres in length. Stenotic breathing again occurs. Reintubation is unsuccessful. Secondary tracheotomy is performed, and after opening the trachea, the child again expectorated a membrane 9 centimetres long, a cast of the trachea and bifurcation. October 5, the child dies with symptoms of bronchitis crouposa and pneumonia.

4. H., a boy* five years old, taken ill February 24, 1893, with faucial and nasal diphtheria. February 26, voice hoarse, breathing rather difficult. Early February 27, stenosis in such a marked degree that intubation seems urgent. The introduction of the tube is very difficult. Intubation followed by asphyxia.

Immediate extubation does not relieve the asphyxia. The administration of strong wine, however, causes violent coughing, by means of which, a thick pseudo-membrane is expectorated. The membrane is 11 centimetres long, and shows a perfect cast of the trachea and the bifurcation. Although the breathing is quite free after expectoration, reintubation is performed. Breathing clear until towards evening; during the night of February 27 and 28, symptoms of bronchitis crouposa appear, and on the afternoon of March 1, the child dies.

In the treatment of more than 500 patients, occlusion of the tube by pseudo-membrane occurred in several instances. The obstruction of the tube generally resulted in violent coughing, which caused the expulsion of both tube and membranes. The ejected membranes were frequently of imposing size. If the patient did not cough out the occluded tube, immediate extubation generally gave relief. When the membranes were not removed with the tube, they were almost instantly coughed out. I, myself, have never observed a case where occlusion of the tube resulted in death.

As, in the hospital under my direction, extubation, from the first was performed by means of the thread attached to the tube, it was often done in cases of sudden danger, by the nurse in charge, the inspecting physician being informed after the successful extubation, because reintubation might become necessary.

*This case I observed in my private practice, with my friends, the head physician, Dr. Farkas, and Dr. Kővér.

In my opinion, occlusion of the tube can hardly result in death, if the patient is under continual observation and the cord is left attached. Guyer,* of Zürich, was the first to perform extubation by means of the cord; Ganghofner followed his example; by their advice, I practiced it myself. It affords me pleasure to observe that American operators also avoid the systematic use of the extubator.

Sustained by my own experience, I express my opinion respecting the questions under discussion, as follows:

1. The pushing down of pseudo-membranes—during intubation—is but seldom observed, and is fatal only in very rare cases. The resulting asphyxia can generally be overcome by immediate extubation, as the loosened membrane is expectorated, immediately after the removal of the tube, so to speak. But if this is not the case, artificial respiration or secondary tracheotomy respectively may be performed.

Occlusion of the tube by pseudo-membranes is not a frequent complication, and if it does happen, is generally made harmless by expectoration of the tube. To prevent eventual occlusion from becoming fatal, the patient should be under continual observation. The constant supervision of a trained nurse is essential.

Leaving the cord and fastening it around the neck, enables even an inexperienced person to perform extubation in case of occlusion.

The pushing down of pseudo-membranes and obstruction of the tube by pseudo-membranes form, undoubtedly, a dark side of O'Dwyer's method, yet, in discussing the operation, these comparatively rare complications must retire to the background, when comparing them with the brilliant results obtained by intubation, for the simplest surgical procedure may end fatally for the patient. And if we compare intubation with tracheotomy and observe the results of both methods of operating, we must acknowledge that tracheotomy is much more dangerous than intubation.

As Ferdinando Massei, the Italian laryngologist, says: "The possibility of pushing down pseudo-membrane is a convincing proof that O'Dwyer's operation, although a bloodless procedure,

*Correspondenzblatt f. Schweizer Aerzte, 1889.

is not without danger;”* yet this disadvantage, it seems to me, ought not to prevent us from practicing this humane operation, a blessing to mankind, in ever widening circles.

*“Questo pericolo rappresenta la larva che ogni operatore si trova davanti ed è la dimostrazione irrefragabile che la intubazione, ben che incrinata, non è scevra di pericoli.” L'intubazione della laringe. Napoli.

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